USB I/O Card model A and B

User Manual

October 2013

Table of Contents

1 Features **4**

2 Technical Specifications **4**

3 Interfacing **5**
- Board Overview 5
- INPUTS Connector 6
- OUTPUTS Connector 6
- PWM1-8 Connector 7
- PWM9-16 Connector 7
- Temperature Sensor 8
- LED Driver 8
  - Model A 8
  - Model B 8

4 Software **9**
- Overview 9
  - Linux 9
- Program axiiocardgui 10
  - User Interface 10
  - Command Line 14
  - Distribution Package 14
  - Installation 15
  - Software Revision 15
  - Software License 15
- Package libaxiiocard 16
  - Notes 16
  - Software Revision 16
- Package libaxiiocard-java 16
  - Software Revision 16

5 USB Interface **17**
- Serial Paths 17
  - Linux 17
  - Windows 18

6 Application Notes **19**

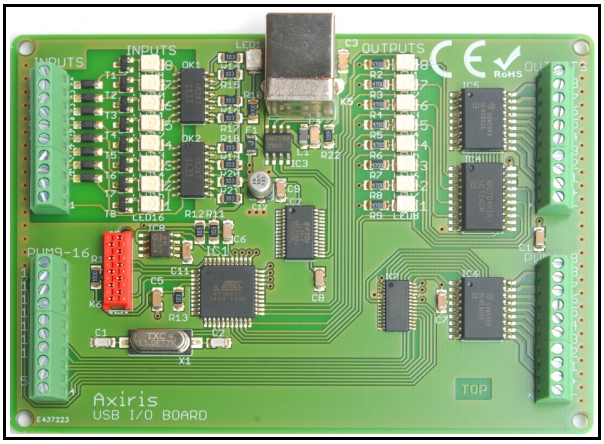
7 Disclaimer **20**

8 Contact Information **20**

Revision History

Date	Authors	Description
2012-08-20	Peter S'heeren	Initial release.
2012-11-25	Peter S'heeren	Added model B. Second release.
2013-03-11	Peter S'heeren	Added sections about software and serial interface. Third release.
2013-10-27	Peter S'heeren	Updated for latest axiiocardgui program (issued 2013-10-27). Added sections for libaxiiocard and libaxiiocard-java (issued 2013-10-27). Fourth release.

1 Features



- USB 2.0 Full-Speed serial interface.
- USB bus-powered.
- *Model A and B* - LED driver provides 16 pulse-width modulation (PWM) output channels:
  - 8 open-collector outputs.
  - 8 TTL outputs.
- *Model A* - 16 output channels providing 8-bit pulse-width modulation (PWM) at 97 kHz.
- *Model B* - 16 output channels providing 12-bit pulse-width modulation (PWM) output channels at about 40 to 1000 Hz.
- 8 opto-isolated input channels.
- 8 open-collector output channels.
- Ultra high accuracy digital temperature sensor.

Applications include:

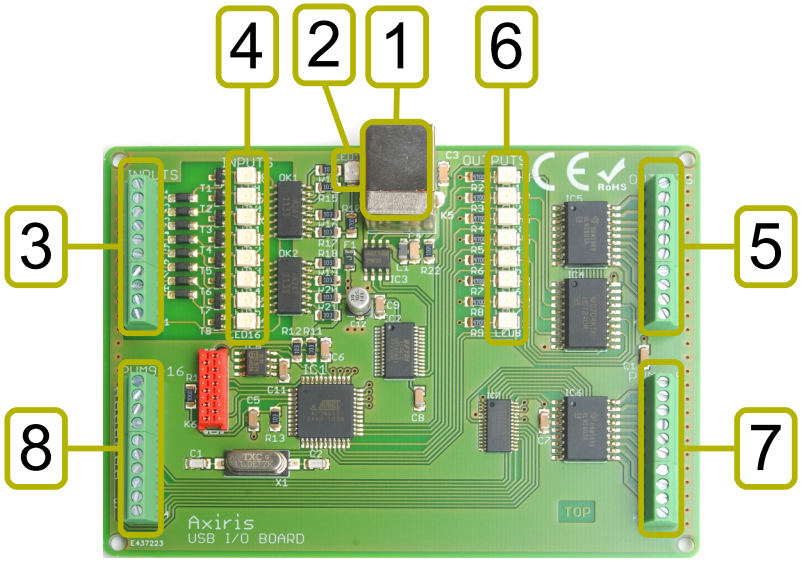
- Home automation (domotics).
- Industrial automation.
- RGB LED control.
- *Model B* - Motor and servo control.

2 Technical Specifications

Power supply	USB bus-powered 500 mA max.
Dimensions	105 mm x 76 mm x 15 mm (W x D x H)
Weight	51 g

3 Interfacing

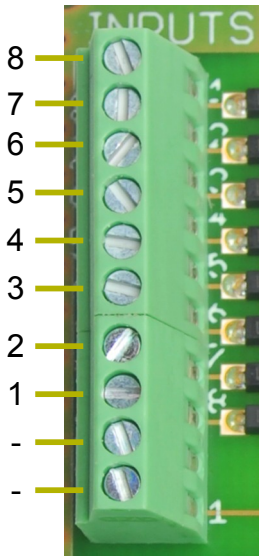
Board Overview



Mark	Label	Description
1	K5	USB connector
2	LED17	Power LED indicator
3	INPUTS	Input channels
4	INPUTS[1..8]	Input channels state LED indicators
5	OUTPUTS	Output channels
6	OUTPUTS[1..8]	Output channels state LED indicators
7	PWM1-8	PWM output channels 1..8
8	PWM9-16	PWM output channels 9..16

INPUTS Connector

Mark	Description
8	Input channel 8
7	Input channel 7
6	Input channel 6
5	Input channel 5
4	Input channel 4
3	Input channel 3
2	Input channel 2
1	Input channel 1
-	Ground
-	Ground

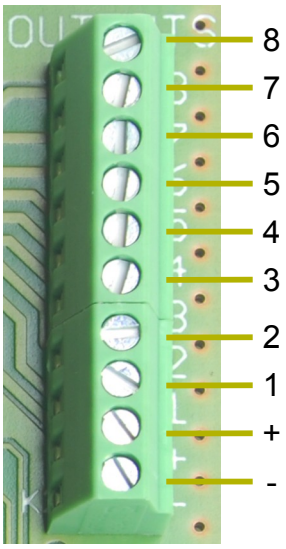


The input voltage range on the input channels is 5 – 30 V. Such input voltage is seen as a logical one.

The input channels are galvanically isolated from the rest of the circuit.

OUTPUTS Connector

Mark	Description
8	Output channel 8
7	Output channel 7
6	Output channel 6
5	Output channel 5
4	Output channel 4
3	Output channel 3
2	Output channel 2
1	Output channel 1
+	Positive load voltage
-	Ground



The output channels are open-collector outputs that switch to ground. Each output can drive max. 500 mA at 50 V. The max. output current of all outputs together is 1 A.

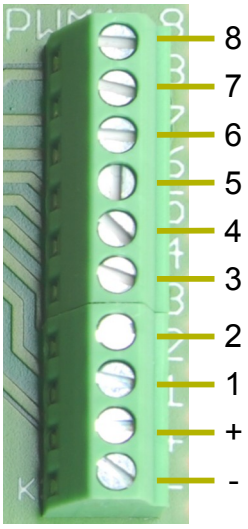
For inductive loads it's recommended to connect the positive supply voltage of the load to the positive load voltage terminal.

When driving inductive loads (for example, relays) it's also recommended to connect a

clamp diode across the load.

PWM1-8 Connector

Mark	Description
8	PWM output channel 8
7	PWM output channel 7
6	PWM output channel 6
5	PWM output channel 5
4	PWM output channel 4
3	PWM output channel 3
2	PWM output channel 2
1	PWM output channel 1
+	Positive load voltage
-	Ground

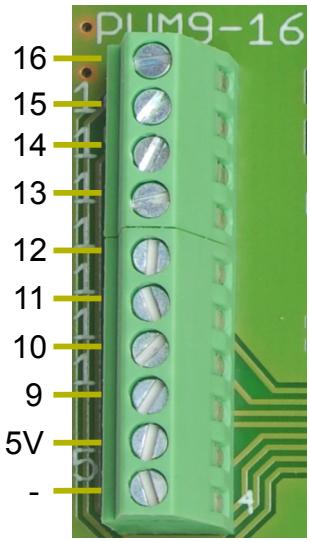


These output channels are meant for driving LEDs. It's not recommended to drive inductive loads.

The output channels are open-collector outputs that switch to ground. Each output can drive max. 500 mA at 50 V. The max. output current of all outputs together is 1 A.

PWM9-16 Connector

Mark	Description
16	PWM output channel 16
15	PWM output channel 15
14	PWM output channel 14
13	PWM output channel 13
12	PWM output channel 12
11	PWM output channel 11
10	PWM output channel 10
9	PWM output channel 9
5V	USB voltage supply
-	Ground



These output channels are 5V TTL compatible.

The voltage supplied on the 5V terminal comes directly from the USB connector. Be careful not to draw too much current from this connector.

In combination with a resistor and a capacitor, an output channel can be set up as an analog output in the range 0 – 5 V.

Temperature Sensor

The NXP SE95 is a temperature-to-digital converter using an on-chip band gap temperature sensor and sigma-delta analog-to-digital conversion. The SE95 is compatible with the LM75/LM75A.

LED Driver

Model A

The NXP PCA9635 is an 8-bit PWM LED driver optimized for red/green/blue/amber (RGBA) color mixing applications.

The PCA9635 uses a frequency of 97 kHz for PWM control. An additional frequency of 190 Hz provides the dimming feature.

Model B

The NXP PCA9685 is a PWM LED driver optimized for red/green/blue/amber (RGBA) color mixing applications.

The PCA9685 uses a frequency of about 40 to 1000 Hz for PWM control enabling it to drive motors and servos.

The on and off times of the PWM output signal can be programmed for each channel individually. This design aids in minimizing current surges.

4 Software

Overview

The USB I/O Card comes with a number of software programs that run on a number of computer systems and operating systems. Since the I/O card is USB-based, it can be easily deployed on a great number of systems.

Linux

This document makes the following assumptions for Linux users:

- You've basic knowledge of Linux commands.
- You've a personal log in that's not root (unless you always log in as root).
- You know how to run programs as root (**sudo** command, setuid access right flag).
- You know how to log in as root (log in prompt, the **su** command).

This document describes commands entered at the command prompt. When entering a command at the prompt of your personal log in, the document uses the $ notation. For example:

```
$ sudo lsof -p 1234
```

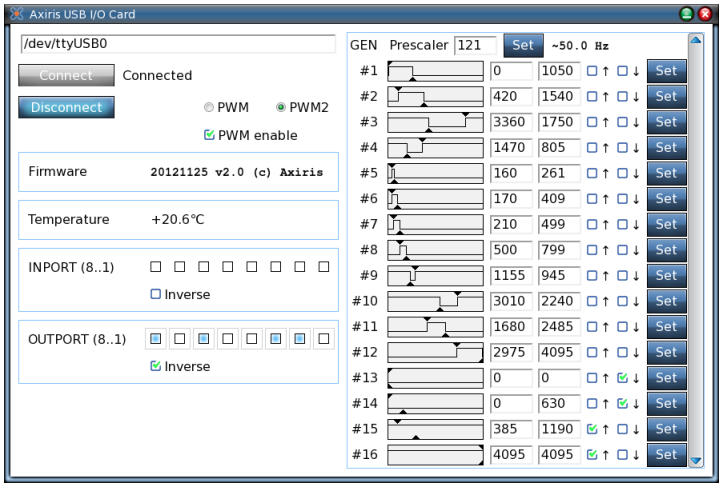
A command entered at the prompt of the root log in is written with the # notation. For example:

```
# ls -al
```

Program axiiocardgui

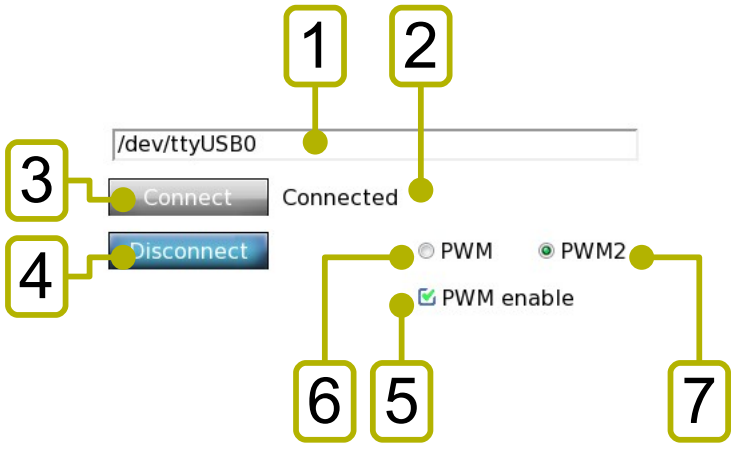
The **axiiocardgui** program is a graphical front-end application that visualizes the state of the USB I/O Card and allows the user to interact with the USB I/O Card.

The program runs on a variety of systems including Linux for x86 and ARM, and Windows 2000 and later.



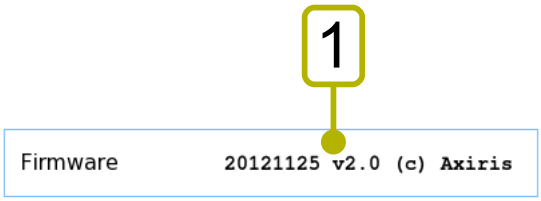
User Interface

The Interface Panel



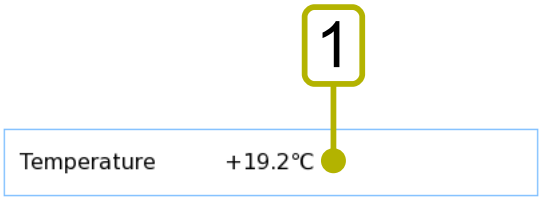
Mark	Description
1	Enter the path to the serial port here. The USB driver creates the serial path.
2	Status information is displayed here.
3	Click the Connect button to connect with the USB I/O Card.
4	Click the Disconnect button to disconnect from the USB I/O Card.
5	Check to enable the outputs of the LED driver (model A and B).
6	Click the PWM button to show the panel for the LED driver of model A.
7	Click the PWM2 button to show the panel for the LED driver of model B.

The Firmware Version Panel



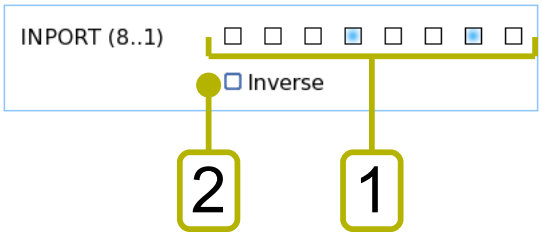
Mark	Description
1	The firmware version string reported by the USB I/O Card during enumeration.

The Temperature Panel



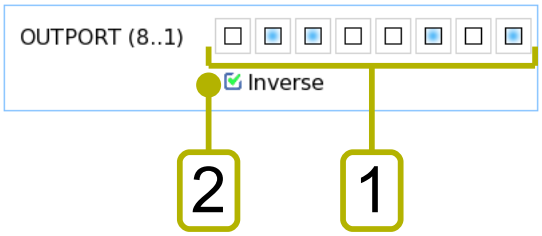
Mark	Description
1	The current value measured by the temperature sensor.

The Input Port Panel



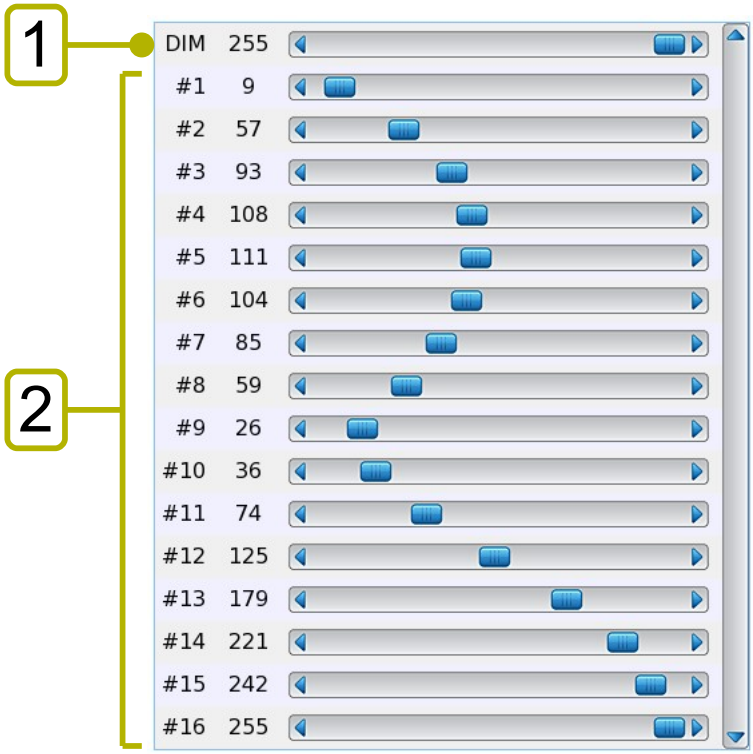
Mark	Description
1	The current state of the input channels.
2	Inverse logic checkbox. This checkbox is a visual-only control. Toggling it does not change the state of the input channels.

The Output Port Panel



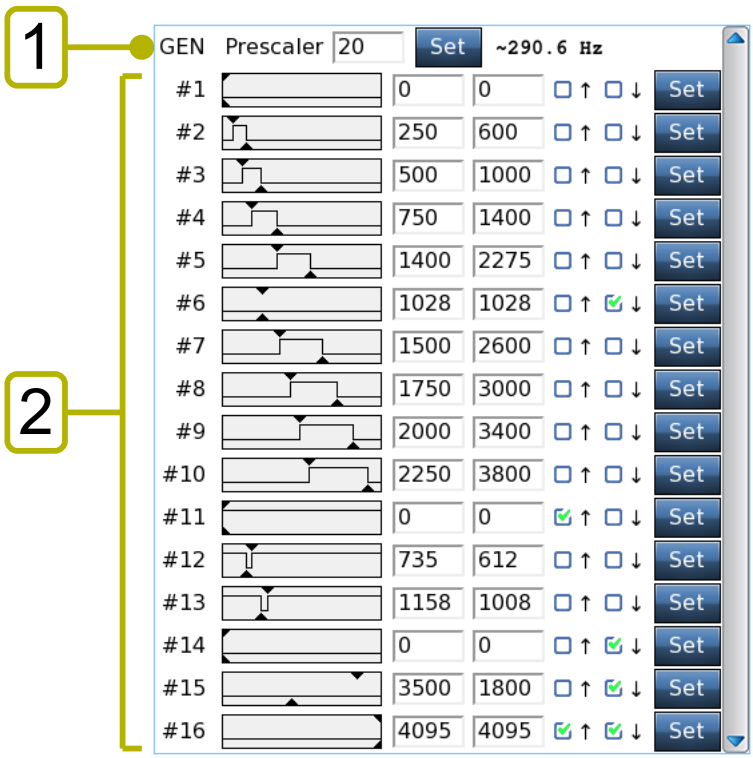
Mark	Description
1	The current state of the output channels. Click to toggle the output state.
2	Inverse logic checkbox. This checkbox is a visual-only control. Toggling it does not change the state of the output channels.

The LED Driver Panel for model A

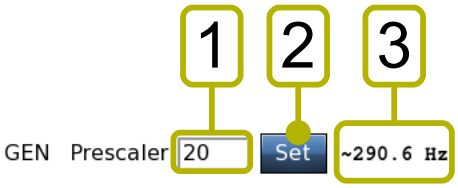


Mark	Description
1	The state of the PWMGRP register. Slide the scrollbar to adjust the value.
2	The state of registers PWM0 to PWM15. Slide a scrollbar to adjust the value.

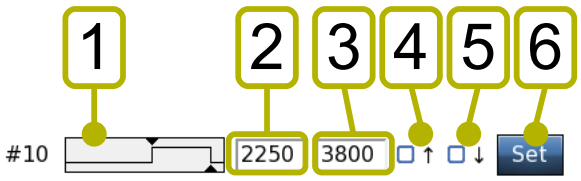
The LED Driver Panel for model B



Mark	Description
1	General settings of the LED driver.
2	The state of each output channel.



Mark	Description
1	The prescaler value.
2	Click the Set button to write the prescaler value to the LED driver.
3	The calculated PWM frequency based on the prescaler value.



Mark	Description
1	Expected PWM wave form of the output signal. You can click and drag the top triangle and bottom triangle to change the values of ON time and OFF time.
2	The value of the ON time. Click the Set button to apply.
3	The value of the OFF time. Click the Set button to apply.
4	The state of the Always ON flag. Click the Set button to apply.
5	The state of the Always OFF flag. Click the Set button to apply.
6	Click the Set button to write the data specified in 2, 3, 4 and 5 to the LED driver.

Command Line

Not applicable. The program ignores the command line.

Distribution Package

The **axiiocardgui** package is supplied for various operating systems. The naming of the packages is:

axiiocardgui-<arch>.<ext>

Where:

- **<arch>**: Architecture of the target operating system.
- **<ext>**: Extension denoting the format of the package file.

In Linux, you can query the architecture as follows:

```
$ gcc -dumpmachine
```

This command will give you a so-called multiarch tuple, like **arm-linux-gnueabi**. The packages use a short name for the architecture as shown in the following table.

These are the currently available packages, tested with the indicated operating systems. Note that this list is not exhaustive. Check the website for the most up-to-date packages.

Package	Multiarch Tuple	Tested operating systems
axiiocardgui-linux-armel.tar.gz	arm-linux-gnueabi	Linux 3.1.9 ARMv6, 32-bit, soft float
axiiocardgui-linux-armhf.tar.gz	arm-linux-gnueabihf	Linux 3.1.9 ARMv6, 32-bit, hard float
axiiocardgui-linux-i486.tar.gz	i486-linux-gnu	Linux 2.6.32 for x86 32-bit
axiiocardgui-linux-amd64.tar.gz	x86_64-linux-gnu	Linux 2.6.32 for x86 64-bit
axiiocardgui-win32.zip	N.A.	Windows 2000/XP/Vista/7, 32-bit, 64-bit

Note that newer versions of an architecture usually support the provided version. For

example, an **i686** system will usually run **i486** flawlessly.

Installation

Linux

Unpack the **axiiocardgui** package in a local directory in your home directory. Be sure you pick the distribution that corresponds with your operating system.

Run the **install.sh** script in the context of your user account to install the **axiiocardgui** program in Linux.

Be sure to run the installation script from the command line rather than the file manager. The script will **sudo** and as such the system may ask for the root password.

The installation script will install the files in directory **/opt/axiiocardgui**.

The installation script will add a icon on your desktop by placing a desktop file in the Desktop directory in your home directory. This feature works only if your window manager is compliant with the Desktop Entry Specification by the **freedesktop.org** organization.

Windows

Unpack the **axiiocardgui** package for Win32 in a local directory on your system.

Execute **axiiocardgui.exe** to run the application. You may create a shortcut to the executable file on your desktop.

Software Revision

Program **axiiocardgui** version 1.2 issued on 2013-10-27.

Software License

The computer program **axiiocardgui** is free of charge ("freeware").

It's allowed to copy or distribute the software providing that you do so with the distribution in its entirety as described in chapter Distribution. It's forbidden to change the software or any other files that are part of the distribution.

It's forbidden to sell, rent, or profit from the distribution in its entirety or the software or any other files that are part of the distribution.

It's allowed to spread the distribution in a packaging format different from the packaging format provided by Axiris.

Package libaxiiocard

The **libaxiiocard** packages provide a library that you can use in your own program for controlling one or more USB I/O Cards.

This library is available in various packages:

- **libaxiiocard-gcc4**: Package for use with GCC version 4 or later.
- **libaxiiocard-msvc60**: Package for use with Visual Studio 6.0 or later.

Each package contains documentation. Refer to the readme file for more information.

Notes

This package with major version 2 is incompatible with its predecessor which has major version 1. The main differences are:

Component	Version 1	Version 2
Name of header file	`axiiocard.h`	`libaxiiocard.h`
Namespace prefixes	`AXIIOCARD_` `LIBAXIIOCARD_`	`LIBAXIIOCARD_`
User definitions	`LIBAXIIOCARD_EXPORTS`	`LIBAXIIOCARD_EXPORTS` `LIBAXIIOCARD_DYNLL`

Handle types and related allocation functions	`<none>`:
	▪ `AXIIOCARD_Init()`
	▪ `AXIIOCARD_Deinit()`
	`AXIIOCARD_HANDLE`
	▪ `AXIIOCARD_Connect()`
	▪ `AXIIOCARD_Disconnect()`
		`LIBAXIIOCARD_LIB_HANDLE`
		▪ `LIBAXIIOCARD_Init()`
		▪ `LIBAXIIOCARD_Deinit()`
		`LIBAXIIOCARD_HANDLE`
		▪ `LIBAXIIOCARD_Connect()`
		▪ `LIBAXIIOCARD_Disconnect()`

Software Revision

Package **libaxiiocard** version 2 issued on 2013-10-27.

Package libaxiiocard-java

The **libaxiiocard-java** packages provide a Java binding with the **libaxiiocard** library.

This software is available in various packages:

- **libaxiiocard-java-linux**: Java binding for Linux.
- **libaxiiocard-java-win32**: Java binding for Win32.

Each package contains documentation. Refer to the readme file for more information.

Software Revision

Package **libaxiiocard-java** issued on 2013-10-27.

5 USB Interface

The USB I/O Card incorporates an FTDI USB to serial chip. This chip needs the Virtual COM port (VCP) drivers supplied by FTDI. These drivers are available for most common operating systems.

Serial Paths

You need to specify a serial path in order to communicate with a serial port. The next sections explain in more detail how you specify serial paths in each supported operating system.

Linux

Serial ports are accessible in the device directory structure. A serial path starts with **/dev**. A serial path is case-sensitive.

The following table summarizes serial paths that are commonly found on Linux systems:

Serial Path	Serial Port
/dev/ttyS0	The computer's 1st on-board serial port
/dev/ttyS1	The computer's 2nd on-board serial port
/dev/ttyS2	The computer's 3rd on-board serial port
/dev/ttyS3	The computer's 4th on-board serial port
/dev/ttyUSB0	1st USB serial adapter
/dev/ttyUSB1	2nd USB serial adapter
/dev/serial/by-id/	This directory contains symbolic links to serial devices. Each symbolic link name identifies a specific device.
/dev/serial/by-path/	This directory contains symbolic links to serial devices. Each symbolic link name represents a hardware path to the device, like a specific USB port on your computer.

Here are some useful commands you can run to get information about present serial devices and their corresponding serial path. The following commands were run on a Linux system with one on-board UART and one connected USB serial adapter.

Filter information from the kernel message buffer:

```
$ dmesg | grep 'tty'
[    0.000000] console [tty0] enabled
[    0.516785] serial8250: ttyS0 at I/O 0x3f8 (irq = 4) is a 16550A
[    0.517463] 00:0b: ttyS0 at I/O 0x3f8 (irq = 4) is a 16550A
[    0.559097] tty tty55: hash matches
[   66.076326] usb 2-1: FTDI USB Serial Device converter now attached to ttyUSB0
```

Use the **setserial** command to produce a list of serial paths:

```
$ setserial -g /dev/ttyS* /dev/ttyUSB*
/dev/ttyS0, UART: 16550A, Port: 0x03f8, IRQ: 4
/dev/ttyS1, UART: unknown, Port: 0x02f8, IRQ: 3
/dev/ttyS2, UART: unknown, Port: 0x03e8, IRQ: 4
/dev/ttyS3, UART: unknown, Port: 0x02e8, IRQ: 3
/dev/ttyUSB0, UART: unknown, Port: 0x0000, IRQ: 0, Flags: low_latency
```

List serial devices in the device directory:

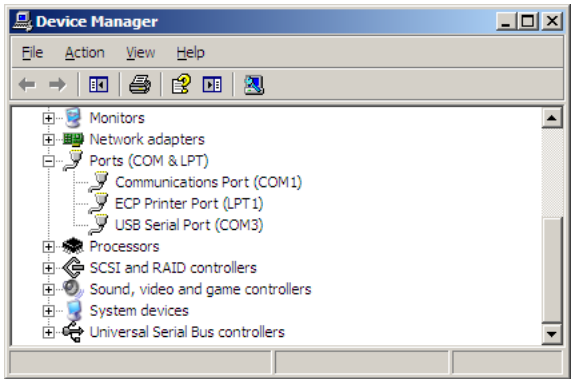
```
$ ls -l /dev/ttyS* /dev/ttyUSB*
crw-rw---- 1 root dialout   4, 64 2012-02-22 14:19 /dev/ttyS0
crw-rw---- 1 root dialout   4, 65 2012-02-22 14:19 /dev/ttyS1
crw-rw---- 1 root dialout   4, 66 2012-02-22 14:19 /dev/ttyS2
crw-rw---- 1 root dialout   4, 67 2012-02-22 14:19 /dev/ttyS3
crw-rw---- 1 root dialout 188,  0 2012-02-22 14:20 /dev/ttyUSB0
```

Windows

Serial ports are accessible through the Win32 device namespace, which is part of the NT namespace. As such a serial path starts with **\\.** followed by the device name of the serial port. A serial path is case-insensitive.

A serial port is typically named **COM<x>** where **<x>** is a number between 1 and 256. Other naming schemes may apply and aliases may exist, depending on the serial driver that controls the serial port.

You can obtain a list of available serial ports in the device manager. Open the device manager and view devices by type. The section named *Ports (COM & LPT)* contains all available serial and parallel ports.



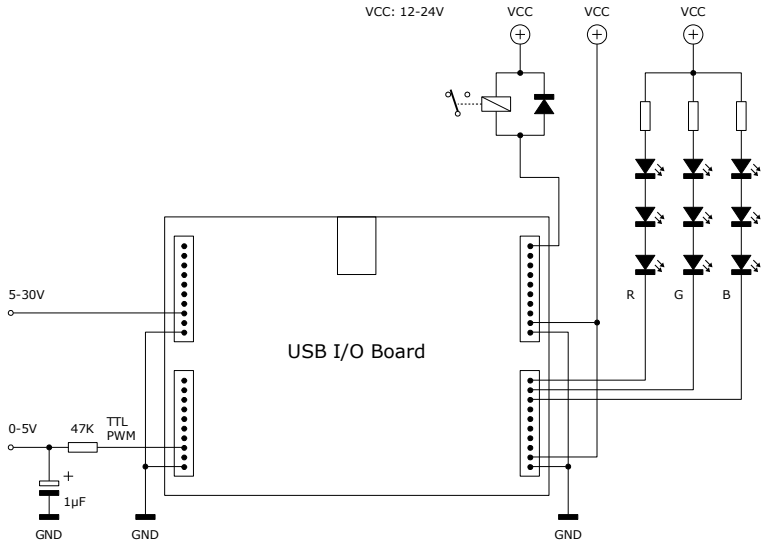
The device name of a serial port is shown between parentheses. In the picture to the right, you can see two serial ports. COM1 is the PC's on-board serial port, COM3 represents a USB serial adapter.

The serial paths to the serial ports in the picture are:

Serial Path	Serial Port
\\.\COM1	*Communications Port (COM1)*
\\.\COM3	*USB Serial Port (COM3)*

Serial paths like **COM1** (that's without the **\\.** prefix) will work because COM1 to COM9 are reserved names in the NT namespace. COM10 to COM256 aren't reserved names and you'll have to specify the **\\.** prefix with these device names. By comparison, serial path **\\.\COM100** will work but serial path **COM100** won't work.

6 Application Notes



Overview:

- Output 8 is connected to a relay.
- PWM outputs 6 to 8 drive blue, green, and red LEDs.
- PWM output 9 is used for generating a voltage between 0 and 5 V.
- Input 1 reports logic level one when a voltage of 5 to 30 V is applied.

7 Disclaimer

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8 Contact Information

Official website: http://www.axiris.be/